California Regional Water Quality Control Board
Santa Ana Region

January 18, 2006

ITEM : 12

SUBJECT: Lake Elsinore and Canyon Lake Nutrient TMDLs

The Board's consideration of approval of the monitoring programs proposed by stakeholders has been postponed. At the Board meeting, staff will provide an update on the status of the monitoring programs. The attached draft monitoring reports are for the Board's information.

Item 12

United States Department of Agriculture
Forest Service
San Bernardino National Forest Supervisor's Office
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HAS

2006 JAN -3 P1

File Code: 2500/2520-1/2520-5
Date: December 30, 2005

Hope Smythe
Chief of Basin Planning, Inland Waters
Santa Ana Regional Water Quality Control Board
3737 Main Street, Suite 500
Riverside, CA 92501

Ms. Smythe:

In accordance with information provided to you at our meeting of December 2, 2005, the San Bernardino National Forest is submitting this sampling and analysis plan (SAP) for monitoring and analyzing the San Jacinto River Watershed of the San Jacinto Ranger District, San Bernardino National Forest for sources of total phosphorous. The Plan also identifies locations for future trend and storm monitoring to address implementation Task 4a of the Lake Elsinore/Canyon Lake Nutrient Total Maximum Daily Load (TMDL) report. Submittal of this SAP by December 31, 2005 meets a compliance date given in the approved Basin Plan amendment.

We look forward to working with you during the evaluation of this monitoring plan, as well as the implementation in the future. We would appreciate a full and complete review of the monitoring plan and a formal acknowledgment of your opinion. Please contact Robert Taylor, Forest Hydrologist, 909-382-2660, with any concerns.

Sincerely,

GENE ZIMMERMAN
Forest Supervisor

cc: Brian Staab, Douglas Pumphrey, Laurie Rosenthal, Bernice Bigelow

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Introduction

To address implementation Task 4a of the Lake Elsinore/Canyon Lake nutrient Total Maximum Daily Load (TMDL) report, and to provide information for future management and planning, the San Bernardino National Forest (SBNF), in conjunction with the Cleveland National Forest, has developed this sampling and analysis plan (SAP) for monitoring and analyzing the San Bernardino National Forest, San Jacinto Ranger District for sources of total phosphorous and to identify a location for future trend and storm monitoring.

This SAP is due to Santa Ana Regional Water Quality Control Board (RWQCB) by December 31, 2005 to meet an implementation deadline of the TMDL. An annual report is due annually by August 15. This SAP may be amended and updated by Dec. 31, 2006.

This report uses the format presented by the Environmental Protection Agency (EPA) (2002) Data Quality Objectives (DQO) process. EPA recommends using the DQO Process when data are being used to select between two opposing conditions, such as determining compliance with a standard. The DQO process:

• Provides a good way to document the key activities and decisions necessary to address the problem and to communicate the approach to others.

• Involves key decision makers, other data users, and technical experts in the planning process before data collection begins which helps lead to a consensus prior to beginning the project and makes it easier to change plans when circumstances warrant because involved parties share common understandings, goals, and objectives.

• Develops a consensus approach to limiting decision errors that strikes a balance between the cost of an incorrect decision and the cost of reducing or eliminating the possible mistake.

• Saves money by greatly reducing the tendency to collect unneeded data by encouraging the decision makers to focus on data that support only the decision(s) necessary to solve the problem(s). When used with a broader perspective in mind, however, the DQO Process may help identify opportunities to consolidate multiple tasks and improve the efficiency of the data collection effort.

In the Addendum Staff report to the TMDL (December 2004), the RWQCB staff stated, "The modeled phosphorus load from the forest land in the San Jacinto River watershed is higher than the median and/or average phosphorus load from other western forests in the US. It is unclear to staff if this is due to the fact that some human-induced disturbance is occurring on forested lands (i.e. septic systems, campgrounds, etc). Staff has asked US Forest Service staff to provide information on exact land uses within the lands under their jurisdiction. Until those data are obtained and reviewed, staff determined that a five percent reduction from the current San Jacinto River watershed forest land phosphorus load is needed to ensure that the phosphorus loads are within the range of other natural US forests."

One aspect of the proposed project is to provide RWQCB with the information requested regarding land use and to isolate information about phosphorous loads from lands not under the jurisdiction of the Forest Service.

Step 1: State the Problem

Purpose: To define the problem so that the focus of the study will be unambiguous.

Identify members of the planning team

SBNF Forest Hydrologist: Sampling and Analysis Plan (SAP) primary author, coordinator, data collection, statistical data analysis and conclusions
Lands, Minerals, and Resources Staff Officer on San Bernardino National Forest
Resources Staff Officer on Cleveland National Forest
Region 5 Regional Hydrologist
SBNF Forest Aquatic biologist: consultant on locations of groundwater dependent ecosystems and aquatic resources, intermediary with State Fish & Game and Fish & Wildlife Service about emergency consultation (50 CFR 402.05), labs used, lab standards, other QA/QC
Zone Soil Scientist: consultant on monitoring parameters relative to natural constituents and processes in the watershed in question
Forest Supervisor: line officer, post study decision maker

Primary Decision Maker

Forest Supervisor with consultation from team members: following data analysis, the results will be returned to the Forest Supervisor. If problems identified or future work needed, then the Forest Supervisor will make that decision and justify future work.

Concise Problem Statements

1. Are there sources of phosphorous that can be identified as originating from various land use practices contained in and around portions of the San Bernardino National Forest, San Jacinto Ranger District? Can the land use practices influencing the total phosphorous loading be shown to be statistically significant when comparing upgradient and downgradient data?
2. Can a location be found for compliance monitoring that encompasses a sufficient land area to have a wide cross-section of Forest Service land management strategies while limiting the land area under the jurisdiction of others?

Background Site Conditions

The San Bernardino National Forest, San Jacinto Ranger District falls within the regulatory control of the Santa Ana Regional Water Quality Control Board (RWQCB) on the west and the Colorado River Regional Water Quality Control Board on the east. There are three 5th Field watersheds in the San Jacinto Ranger District that discharge water towards Canyon Lake and Lake Elsinore.

- Upper San Jacinto, #1807020202
- Garner, #1807020201
- Bautista, #1807020203

The surficial geology of the San Jacinto Ranger District is comprised primarily of Mesozoic granitic rocks and alluvium.

The primary variable for the San Jacinto Ranger District relative to the Canyon Lake/Lake Elsinore TMDL is the land owner status of the lands above the USGS Cranston gage used during the modeling process. Data collected at the Cranston gage was used to approximate the total phosphorous loading coming from forest/open space. However, the land uses above the USGS Cranston gage include SBNF lands, the unincorporated community of Idyllwild, lands owned by Lake Hemet Municipal Water District, and various private inholdings devoted to various activities.

On land owned by the SBNF, the multiple use nature of the forest comes into play, with numerous activities including a system of forest roads, campsites, off-highway vehicle/equestrian trails, hiking trails, etc. The Forest Service system roads are maintained for such needs as access to fight wildland fires, conduct fuels treatment projects to deal with mortality from drought and insect infestation, and general access to the intermingled public and private lands. The fuels treatment projects are designed to return the Forest to a fire regime natural for the climate and to protect the community of Idyllwild. All projects conducted on the SBNF are required to use Best Management Practices (BMPs) as detailed in numerous guidance documents (USDA Forest Service, 2000, 2005a, 2005b).

Determination of Resources

Laboratory Anlaysis Costs (Oct 2005 – Sept 2006)	
Cost per sample	$8
Question 1: # of Samples	32
Question 1: # of Constituents	5
Question 2: # of Samples	20
Question 2: # of Constituents	12
Total Analysis Costs for FFY2006	**$3,200**

Personnel and Equipment costs for FFY2006: $7,450

Estimated Total Study Costs for FFY2006: $10,650

Laboratory Anlaysis Costs (Oct 2006 – Sept 2007)	
Cost per sample	$9
Question 1: # of Samples	48
Question 1: # of Constituents	5
Question 2: # of Samples	30
Question 2: # of Constituents	12
Total Analysis Costs for FFY2006	**$5,400**

Personnel and Equipment costs for FFY2007: $9,500

Estimated Total Study Costs for FFY2007: $15,000

Step 2: Identify the Decision

Principle Study Question 1

1. Are there sources of phosphorous coming from Forest Service Land Management Practices and private land management practices statistically above the concentrations found in natural background data?

Alternative Actions & Decision Statements for #1

- If the result of sampling shows that no statistically significant human-caused sources of phosphorous on Forest Service lands above background levels can be identified, then
    - Consultation with the RWQCB will be conducted to determine if the added information is sufficient to re-evaluate the background load level from Forest Service lands,
    - Consultation with the RWQCB will be conducted to determine if the added information is sufficient to remove the Forest Service requirement for phosphorous reduction under the stipulation that continued BMPs be evaluated and reported on in accordance with the Management Area Agreement (MAA) between the Forest Service and the State Water Board.
- If the result of sampling shows statistically significant human-caused source(s) of phosphorous on Forest Service lands above background levels, then
    - If the sources are associated with Forest Service regulated activities, then restoration project(s) to reduce loading to the degree reasonable and feasible will be drafted and put forward for funding in consultation with the RWQCB.

        - Further sampling will be isolated and possibly enhanced in relation to the identified source area, whereas sampling in areas shown to not be sources will be discontinued.
    - If the sources are not associated with Forest Service regulated activities (private in-holdings such as Idyllwild or Lake Hemet), then, in consultation with the RWQCB, the agencies responsible for the activities will be notified and the responsibility for the phosphorous loading will fall under the regulatory purview of the RWQCB.
        - Consultation with the RWQCB will be conducted to determine if the added information is sufficient to re-evaluate the background load level from Forest Service lands,
        - Consultation with the RWQCB will be conducted to determine if the added information is sufficient to remove the Forest Service requirement for phosphorous reduction under the stipulation that continued Best Management Practices (BMPs) be evaluated and reported on in accordance with the Management Area Agreement (MAA) between the Forest Service and the State Water Board.

Principle Study Question 2

What location(s) could provide compliance monitoring station(s) on the San Bernardino National Forest and Cleveland National Forest that will give an adequate measure of Forest Service land management practices but exclude effects from private in-holdings and other non-Forest Service regulated activities?

Alternative Actions & Decision Statements for #2

- If location(s) are found that contain a cross-section of Forest Service land management activities that does not include land from private in-holdings and other non-Forest Service regulated activities, then
    - In consultation with the RWQCB designate this/these location(s) as compliance/trend monitoring stations and determine the on-going monitoring requirements
- If location(s) cannot be found that contain a cross-section of Forest Service land management activities and do not include land from private in-holdings and other non-Forest Service regulated activities, then
    - In consultation with the RWQCB determine what percentage of the measured concentration from those locations can be reasonably attributed to Forest Service land management activities.
    - If reasonable, coordinate with the RWQCB and parties responsible for other in-holdings to establish sampling and monitoring requirements
- In either case, work with RWQCB to establish the correlation between the data collected at the location in question and the nearest USGS gage [Cranston for San Bernardino] to establish the empirical relationship between the two.

- Through this empirical relationship, determine what portion of phosphorous monitored at the nearest watershed wide gage is reasonably attributed to the Forest Service and what portion is not associated with Forest Service regulated activities (private in-holdings such as Idyllwild or Lake Hemet). Then, in consultation with the RWQCB, the agencies responsible for the activities will be notified and the responsibility for the phosphorous loading will fall under the regulatory purview of the RWQCB.

Step 3: Identify Inputs to the Decision

Information required to resolve decision statements

Regional Board TMDL recommendations for parameters

In the *Lake Elsinore and Canyon Lake Nutrient TMDL*, the RWQCB has identified applicable parameters for watershed monitoring consistent with those historically sampled in the watershed. Collection and analysis is recommended for a minimum of three storms per year and for eight samples over each hydrograph, though direction is not given as to how to decide which storms should be sampled. Sampling is not required during dry periods. The following parameters are recommended for measurement:

- Organic nitrogen
- Nitrite nitrogen
- Total phosphorous
- Total Hardness
- Total Suspended Solids
- Biological oxygen demand
- Ammonia nitrogen
- Nitrate nitrogen
- Ortho phosphate (SRP)
- Total dissolved solids
- Turbidity
- Chemical oxygen demand
- pH
- Water Temperature

The RWQCB further recommends in the nutrient TMDL that, at a minimum, daily flow determinations be made at all water quality monitoring stations.

Forest Service suggestions for parameters

Given that the first purpose of the study is to determine possible source(s) of phosphorous from Forest Service regulated activities, and given the difficult budgetary climate with current federal dollars being routed to other national interests, a more limited list of parameters is suggested to resolve the first decision.

- Total phosphorous
- Total Suspended Solids
- Turbidity
- Ortho phosphate (SRP)
- Total dissolved solids
- pH
- Water Temperature

In addition, since the monitoring locations in question will not be monitored by continual monitoring devices, daily flow determinations will not be possible. Instantaneous flow determinations will be made at the times the chemical samples are collected. At each identified location, samples will be collected once every two months, in accordance with Robertson (2003). By collecting data both from an upstream and a downstream location, the area in between the data collection points will be isolated and indicative of the loading from that area of land.

The second study question is to identify a long-term trend monitoring/compliance location on Forest System lands that encompasses a large portion of the watershed and encompasses lands that have Forest Service land management activities associated with them. This trend monitoring site will also help add information to the watershed wide monitoring studies. As the monitoring at this site fulfills different purposes from the source search, the monitored parameters should be different as well. For this single station, the Forest Service recommends sampling for the full suite of constituents recommended by the RWQCB as well as sampling the location for storm-based data. Storm-based data will be used to create hydrograph/pollutographs using the eight hourly samples over the course of a storm. Robertson (2003) recommends that to reduce bias and get the best phosphorous loading result, one year studies should combine fixed period sampling with storm chasing, "even though loads were overestimated by 25 to 50%. For two to three-year load studies and estimating volumetrically weighted mean concentrations, fixed period semimonthly sampling" is a good choice. Though this study is anticipated to be at least 2 years in length, the Forest Service suggests that the combination sampling approach be used.

Locations for sampling

Best professional judgment was used in the determination of sampling locations, giving weight to the locations of Forest Service regulated activities as well as private in-holding activities that are outside the regulatory authority of the Forest Service. Access was also looked at in the decision of applicable sampling sites. The following descriptions indicate the approximate locations that samples will be collected. Prior to the first collection, these locations will be field verified and GPS locations will be recorded for future sample collection activities.

Decision 1

San Bernardino National Forest

- Points upstream and downstream of Idyllwild along Strawberry Creek (Figure B).
    - Upstream: San Jacinto Peak Quad Map, T5S R3E Section 5: San Bernardino FS system road 5S14 is near the boundary between Idyllwild

and Forest Service system lands. This location drains a small land area from Suicide Rock to Marion Mountain to the Pacific Crest National Scenic Trail. The land is expected to give phosphorous concentrations indicative of upper watershed, forest conditions.
  - Downstream: Idyllwild Quad Map, T5S R2E Section 23: Access from the end of roads in Idyllwild is possible and the collection point will be near Forest Service lands. These samples may show indications of the septic systems used in Idyllwild.
- Points upstream and downstream of private in-holdings along Highway 74 above Cranston station contain orchards (Figure C).
  - Upstream: Blackburn Canyon Quad Map, T5S R2E Section 28: A four-wheel drive road paralleling Highway 74 allows access to the South Fork San Jacinto River at the Forest Service boundary. This location encompasses flows from both Strawberry Creek and outflows from Lake Hemet.
  - Downstream: Blackburn Canyon Quad Map, T5S R1E Section 13: The South Fork San Jacinto River at the Forest Service boundary near the Cranston station should be indicative of additions from the North Fork San Jacinto River and overland runoff from orchards grown on private in-holdings, as well as additions from Caltrans activities along this stretch of Highway 74.
- A focused study of both water and soil samples will be conducted in the location of the Idyllwild waste water ponds that are under special use permit with the Forest Service (Figure C). As this permit is up for a new NEPA analysis and a new permit, it is contemplated that future sampling of this site and surrounding tributaries of the San Jacinto River be the responsibility of the permit holder.
- Idyllwild Quad Map; T6S R3E Section 4 and Section 7: this set of points is upstream of Lake Hemet. Downstream information will be coordinated with the Lake Hemet MWD (Figure D).
  - The first upstream location will likely be collected along Herkey Creek in the Herkey Creek County Campground. The drainage to this point will encompass the Herkey Creek watershed including Bonita Vista, the peak north of Pine Springs Ranch, the Fleming Ranch, San Bernardino FS system roads 5S05 and 5S21, the South Ridge Trail, and the Pacific Crest National Scenic Trail. About 25% of the land is private inholdings outside the control of the USFS.
  - The second upstream location will be along Highway 243 on one of the main inlets to Lake Hemet. Sampling will be conducted within the CalTrans Right-of-Way. These samples will encompass loads from a much larger land area, the Garner Valley, Thomas Mountain, Pine Meadow, and surrounding environs. The land use management from this upper includes private and USFS permitting grazing allotments.
  - Coordination will be conducted with the Lake Hemet Water District to take advantage of any sampling currently taking place.

- Points in upper and lower Bautista Canyon (Figure E).
  - Upstream: Blackburn Canyon Quad Map, T6S R2E Section 20: A four-wheel drive road exits Bautista Canyon Road allows access to the Bautista Canyon at the Forest Service boundary. This location encompasses flows from the upper half of the watershed.
  - Downstream: Blackburn Canyon Quad Map, T6S R1E Section 2: Bautista Canyon at the Forest Service boundary has access from the road. This location drains the entirety of the watershed and the majority of the land use is under Forest Service control.

Decision 2

San Bernardino National Forest

- Preliminary investigation of land use management and access indicates a potential sampling location: Lake Fulmor Quad Map, T4S R2E Section 33: Forest Service system road 5S09 crosses the North Fork San Jacinto River. This point will allow sampling of a watershed containing a small piece of Alondale, Pine Wood, the Mount San Jacinto State Wilderness, Forest Service system campgrounds, Highway 243, and Forest Service system roads (Figure A).

Determine the sources of information available

This will be an ongoing activity done in coordination with the RWQCB. Consolidation of monitoring data from the Cranston gage, other sampling such as Lake Hemet, along with an internal search of District and Forest personnel collecting data for other purposes will be conducted. Lessons learned will be incorporated to further reduce costs and increase efficiency.

The Nutrient TMDL and Addendum Staff Report (December 2004) contains the following information regarding the total phosphorous loading from the San Bernardino National Forest. Much of this information was modeled. This study will provide more data into the accuracy of the assumptions used in the model and the final results.

SCENARIO (% OF YEARS)	EXISTING LOADS	WEIGHTED TOTAL
Wet year (16%)	12,093 kg/yr	1,934.9 kg/yr
Moderate year (41%)	315 kg/yr	129.2 kg/yr
Dry year (43%)	196 kg/yr	84.3 kg/yr
	Total	2,148.4 kg/yr

From this information, the RWQCB listed the overall existing load from National Forest lands as 2,144 kg/yr for total phosphorous.

The target level for total phosphorous was determined by using Binkley (2001) information of average phosphorous levels from western forests. Using 0.115 mg/l and an average annual flow rate of 20 cfs, the average loading rate of 2,038 kg/yr was determined.

A 5% reduction from 2,144 kg/yr gives 2,037 kg/yr.

Identify sampling and analysis methods that can meet the data requirements

Field sampling equipment shall include instantaneous flow monitoring equipment, a combination meter for EC, TDS, pH, and temperature, and soil nitrogen-phosphorous kits.

The Forest Service Research Laboratory in Riverside has the capacity and QA/QC protocols to provide analyses for these studies. The Forest Service will cooperate with the RWQCB to ensure that the QA/QC standards meet the needs of the RWQCB.

Step 4: Define the Study Boundaries

Define the target population of interest

Decision 1: The target population of interest is total phosphorous as defined in the TMDL. A limited list of parameters will be collected at these sampling sites.

Question 2: The target population includes the suite of parameters for bi-monthly and storm based data to identify trends in total phosphorous. Data will be used for future modeling exercises to determine a more accurate distribution of loading from forest/open space land management practices.

Define the spatial boundaries that clarify what the data must represent

Identify any practical constraints on data collection (location, safety, weather, etc)

As discussed above, the spatial boundaries of the study consist of Forest Service lands on the San Bernardino and the Cleveland National Forests. The main concern for sampling is access to the site, especially for the storm-based sampling where stormy conditions, forest roads, and low visibility could lead to a hazardous situation.

Define the time frame for collecting data and making the decision

Samples should be taken as soon as the weather allows the Forest Service to establish the GPS locations of the sample sites and to collect baseline conditions of water in the creeks. Once sampling begins, future Federal Fiscal Year (FFY 2007) sampling will require data collection during the same months for future statistical seasonality calculations.

Quality Assurance/quality control samples (e.g. duplicates, blanks, etc) will be required at levels specified to ensure that the laboratory in question meets RWQCB standards.

Determine the smallest subpopulation, area, volume or time for which separate decisions must be made

Decision 1: Given the time frame before the next update of the TMDL and coinciding with the development of the Forest Nutrient Management Plan (Task 8) it is contemplated that the study with encompass one to two-and-a-half years. Annual reports will be submitted showing the laboratory results, though a statistically defensible analysis will not be available until at least nine (9) data points have been taken at each sampling location.

Decision 2: A critical look at land use patterns using GIS technology will be employed in the first 6 months of the plan. The annual report due in August 2006 should have sufficient information to establish the best compliance monitoring location as well as establish what portion of the monitored watershed is under the regulation of the Forest Service.

Step 5: Develop a Decision Rule

Decision 1: As our objective is to compare downgradient locations to upgradient and background conditions to determine if there is a statistically significant increase above the upgradient or background condition, the EPA (2002) suggests that an Action Level need not be specified. Rather, the Action Level is implicitly defined by the upgradient or background concentration levels and the variability in the data. A summary of methods for determining background concentrations is available from numerous sources (EPA 2002).

Decision 2: The Action Level for trend/storm/compliance monitoring point is defined by the current modeling analysis of the TMDL. The long term weighted average calculated load for forest/open space is listed as 2,144 kg/yr. A 5% reduction target gives a level of 2,037 kg/yr. Data collected at the trend/storm/compliance monitoring point will be evaluated using a maximum likelihood estimate for the mean and standard deviation of the data set. These estimates will be calculated when sufficient data is available. Loading calculations will be made using the hydrograph/pollutographs and estimates of duration and frequency of storms. An evaluation will be done on the inherent variability of the data to determine the likelihood of observing a 5% reduction in the collected data.

Step 6: Specify Limits on Decision Errors

Statistical data analysis will be performed using documentation published in various guidances (Conover, 1999; EPA, 1988; EPA, 1992; Gibbons, 1994; Gilbert, 1987; Helsel and Hirsch, 1995; Taylor, 2003). Both parametric and nonparametric analyses will be used depending on the outcome of the samples collected and evaluated. The tests performed will include, but are not limited to, the following:

- Exploratory data analysis (mean, standard deviation, box plots, etc)
- Seasonality check (Kruskal-Wallis)
- Temporal trends (Mann-Kendall, 1975)
- Normality or log-normality (Shapiro-Wilk, 1965)
- Determine the appropriateness of using tolerance limits or prediction limits to determine the best estimate of the mean in the upstream and downstream location
- Compare upstream to downstream to see if there is a statistically defensible change in concentration between the two points.

Identify potential sources of variability and bias in the sampling and measurement processes

From EPA (2000):
The possibility of a decision error exists because the parameter of interest is estimated using data that are never perfect but are subject to different variabilities at different stages of development, from field collection to sample analysis. The combination of all these errors is called "total study error," and for sampling at hazardous waste sites, this can be broken down into two main components:
(1) **Sampling design error**. This error (variability) is influenced by the sample collection design, the number of samples, and the actual variability of the population over space and time. It is impractical to sample every unit of the media, and limited sampling may miss some features of the natural variation of the constituent concentration levels. Sampling design error occurs when the data collection design does not capture the complete variability within the media to the extent appropriate for the decision of interest.

(2) **Measurement error**. This error (variability) is influenced by imperfections in the measurement and analysis system. Random and systematic measurement errors are introduced in the measurement process during physical sample collection, sample handling, sample preparation, sample analysis, and data reduction.

Determine the possible range on the parameter of interest.

Cranston gage data used in Tetra Tech analysis: 33 data: TP (mg/L): mean = 0.50, median = 0.36, range = 0.05 – 2.70

Consider the consequences of making an incorrect decision.

When hypothesis testing is applied to site assessment decisions, the data are used to choose between a presumed baseline condition of the environment and an alternative condition. The test can then be used to show either that the baseline condition is false (and therefore the alternative condition is true) or that there is insufficient evidence to indicate that the baseline condition is false (and therefore the site manager decides by default that the baseline condition is true). The burden of proof is placed on rejecting the baseline condition, because the test-of-hypothesis structure maintains the baseline condition as being true until overwhelming evidence is presented to indicate that the baseline condition is not true.

A decision error occurs when the limited amount of data collected leads the site manager to decide that the baseline condition is false when it is true, or to decide that the baseline condition is true when it is really false. These two types of decision errors are classified as a false rejection error and a false acceptance error, respectively. In some circumstances, a false rejection error is known as a false positive error, and a false acceptance error as a false negative error. In statistical language, the baseline condition is called the null hypothesis (H_0) and the alternative condition is called the alternative hypothesis (H_a). A false rejection decision error occurs when the decision maker rejects the null hypothesis when it is really true; a false acceptance decision error occurs when the decision maker fails to reject the null hypothesis when it is really false.

References

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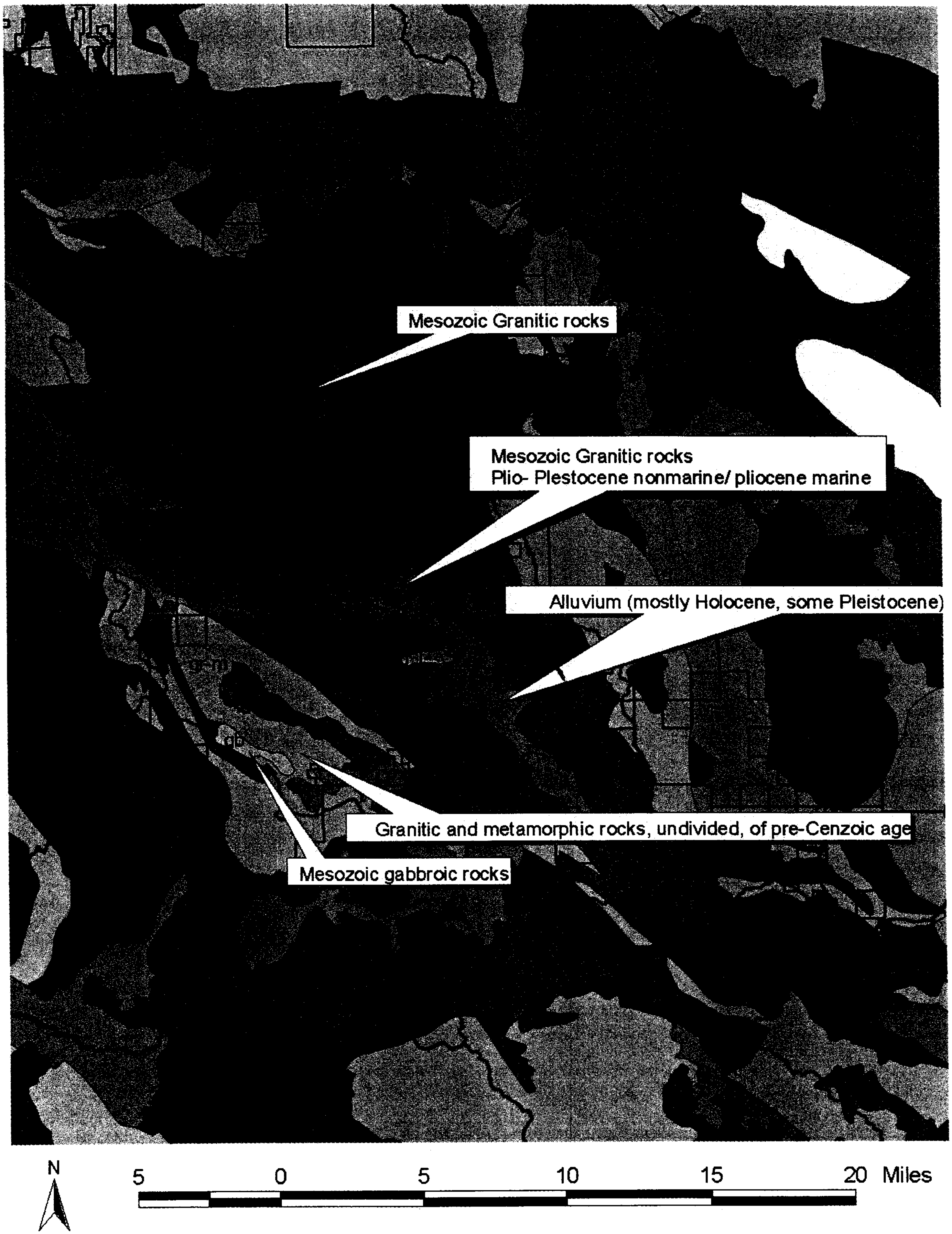
Surficial Geology of San Jacinto Ranger District



Summary of Data Collection Locations on San Jacinto Ranger District for Lake Elsinore/Canyon Lake nutrient TMDL

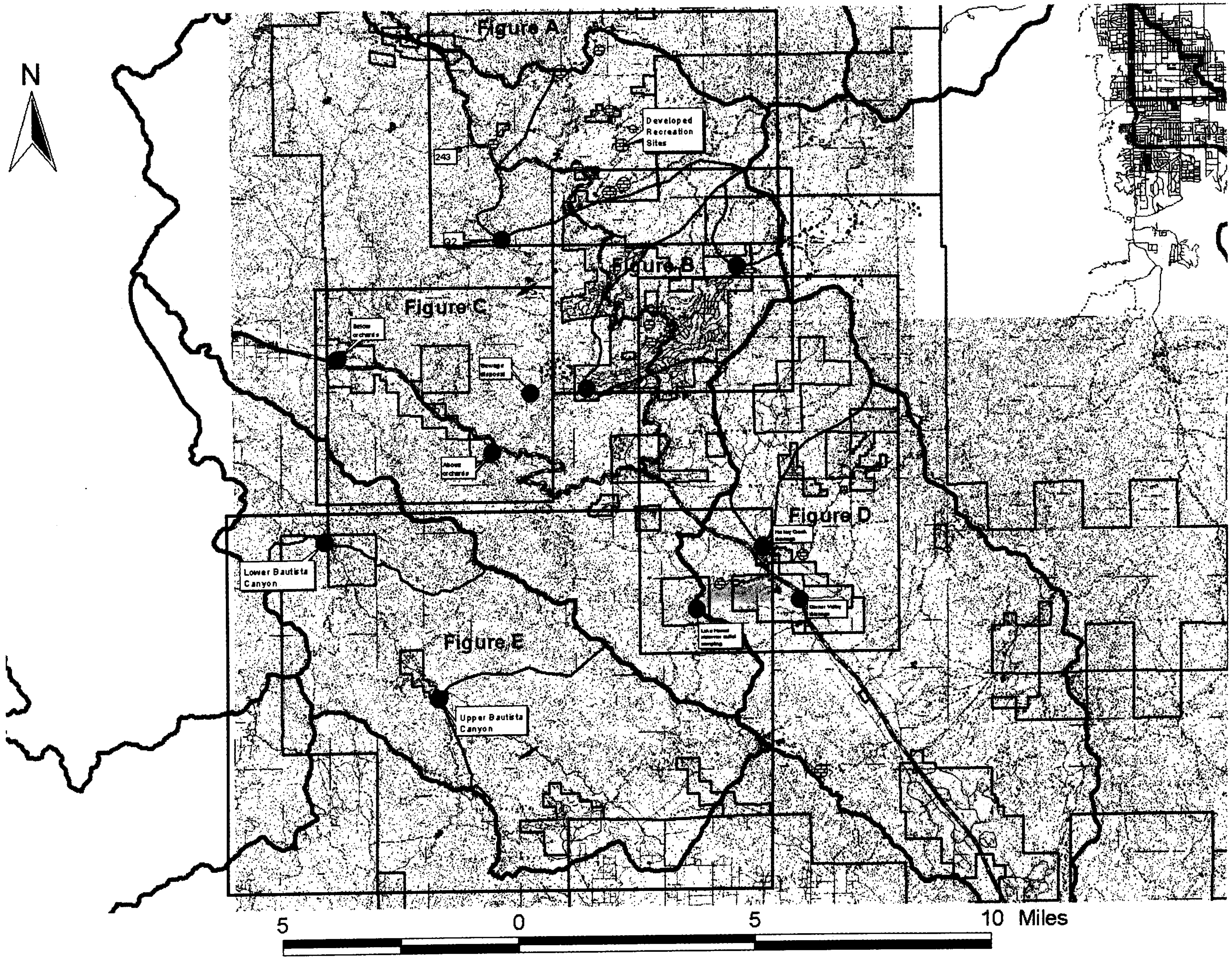


Figure A. Storm tracking location on North Fork San Jacinto River

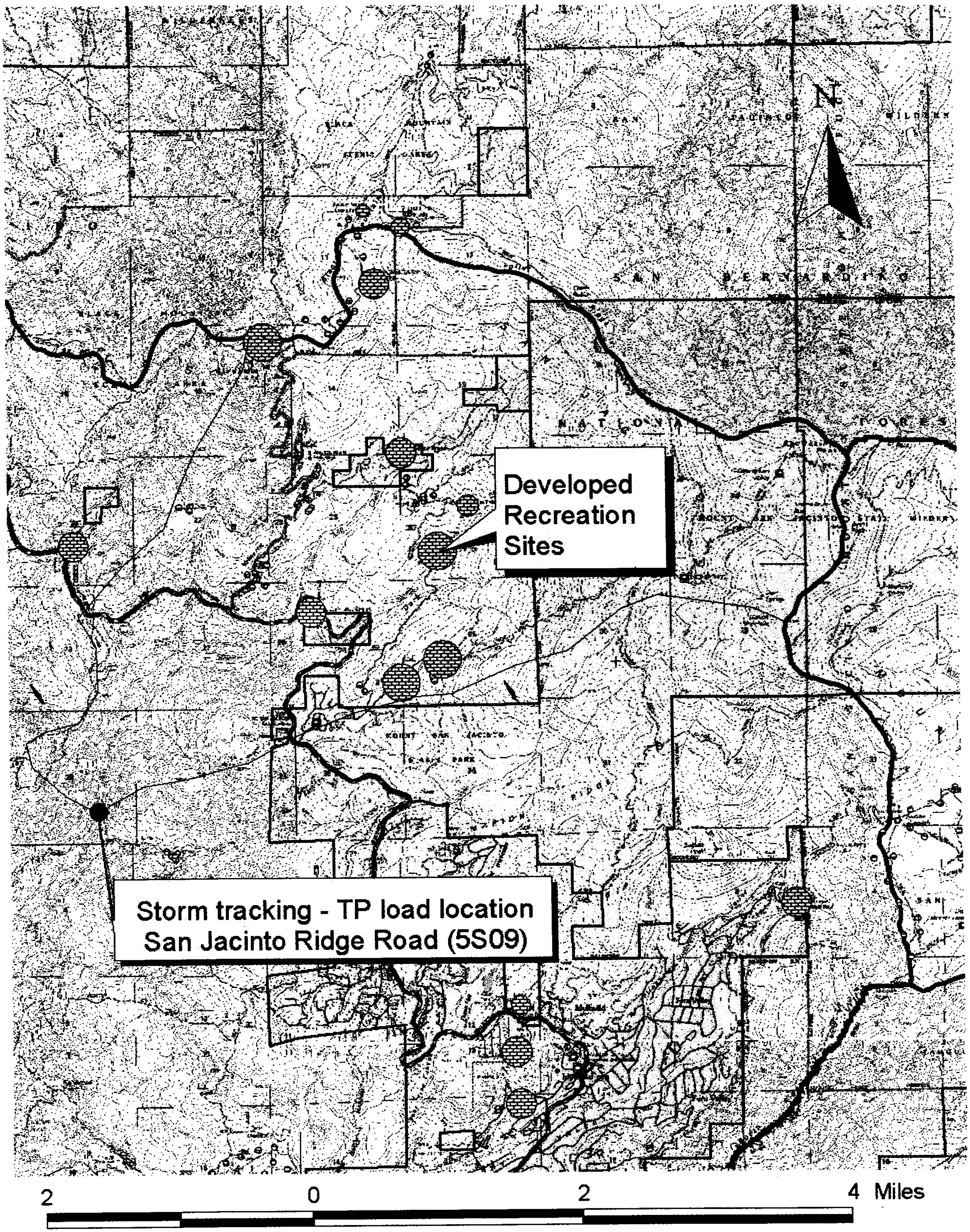


Figure B - Up- and down-gradient sampling stations along Strawberry Creek

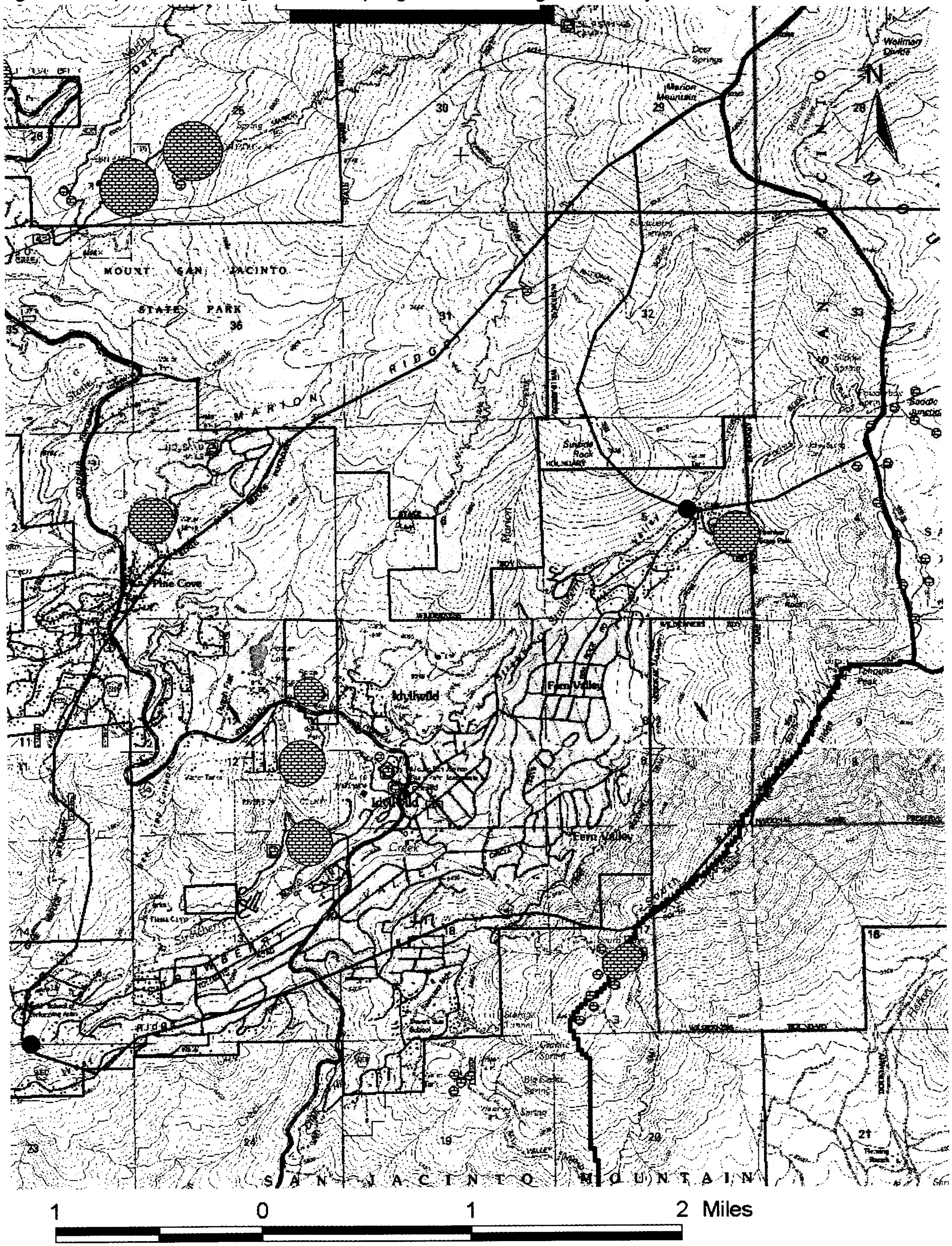


Figure C: Up- and down-gradient of private land orchards and location of Idyllwild sewage treatment ponds

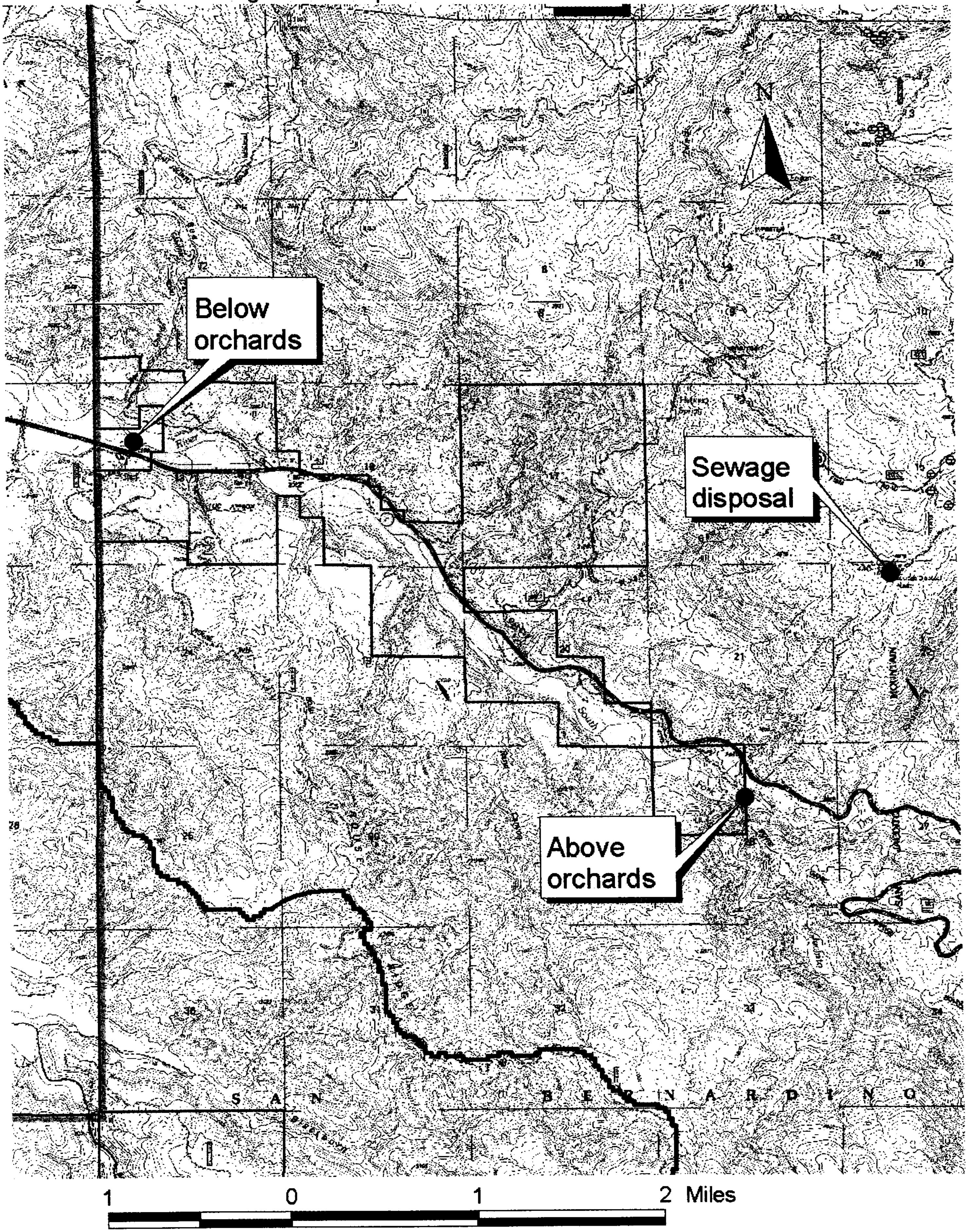


Figure D: Sampling up-gradient of lake Hemet.
Need downstream information for comparison.

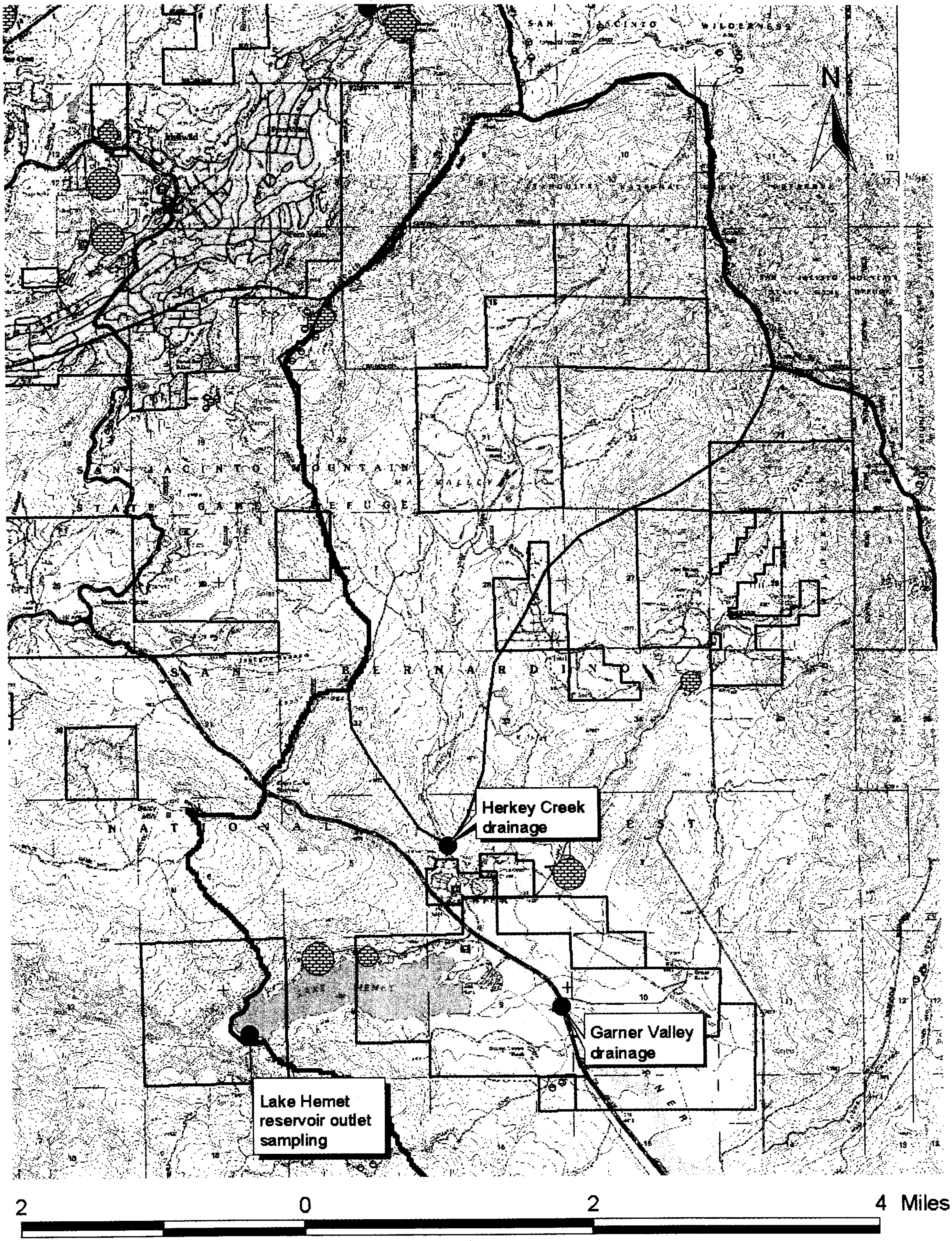
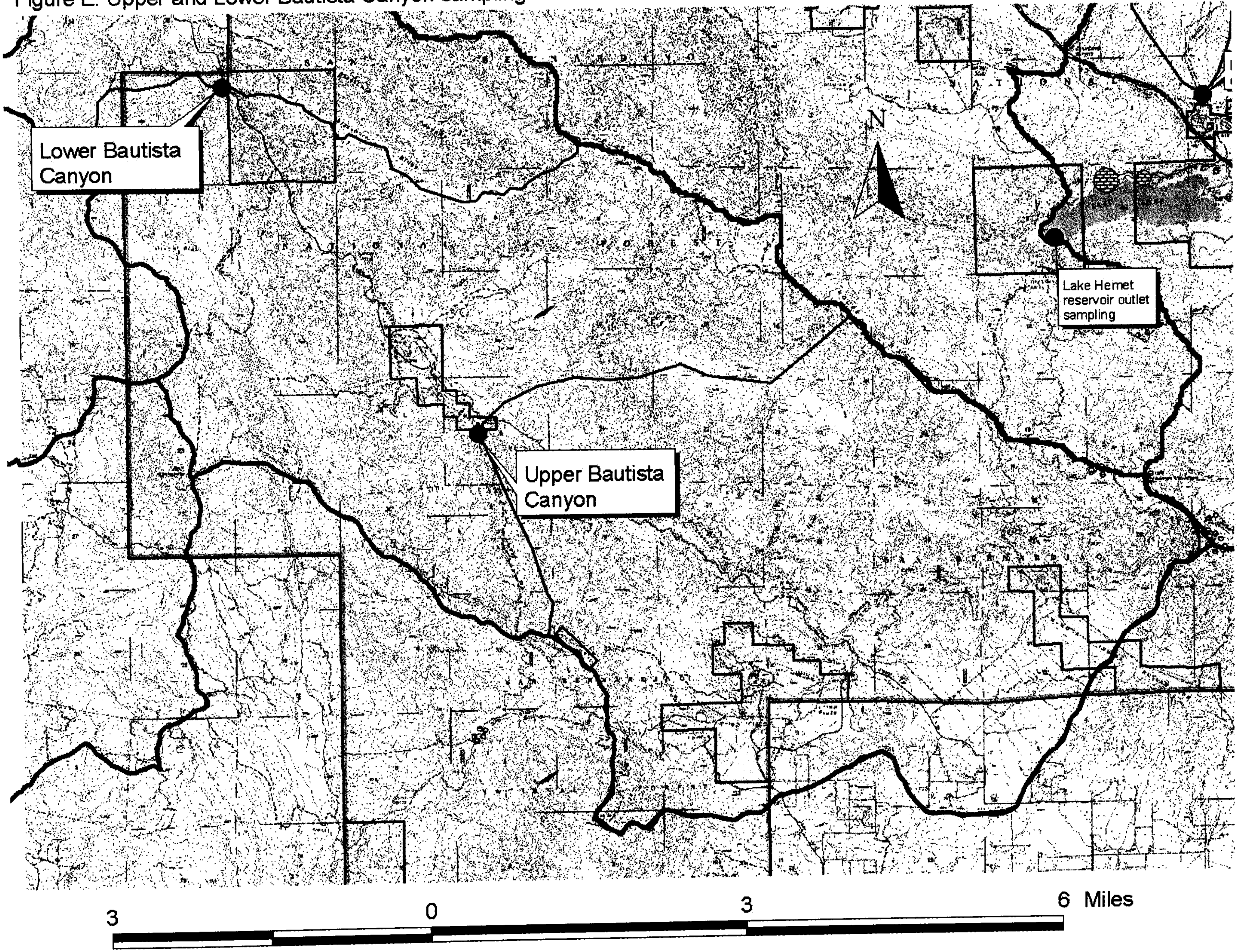


Figure E: Upper and Lower Bautista Canyon sampling



Item #12

Lake Elsinore & San Jacinto Watersheds Authority

City of Lake Elsinore • City of Canyon Lake • County of Riverside
Elsinore Valley Municipal Water District • Santa Ana Watershed Project Authority

Received
DEC
CRWQCB
Santa Ana Region 8

December 21, 2005

Ms. Hope Smythe
Santa Ana Regional Water Quality Control Board
3737 Main Street, Suite 500
Riverside, CA 92501-3339

Dear Ms. Smythe:

On behalf of the stakeholders named to the Lake Elsinore and Canyon Lake Nutrient TMDLs, enclosed for review by the Santa Ana Regional Water Quality Control Board is the DRAFT Lake Elsinore and Canyon Lake Nutrient TMDL Monitoring Plan as required by Resolution No. R8-2004-0037 amending the Basin Plan. This monitoring plan serves to fulfill the requirements of Tasks 4.1, 4.2 and 4.3 of the Basin Plan Amendment; however, at this time the plan has not been formally adopted by the stakeholder group and is subject to further review by stakeholders.

If you have any questions, please feel free to contact me at 951.354.4221.

Sincerely,

Santa Ana Watershed Project Authority

Mark Norton

Mark Norton
Project Director

11615 Sterling Avenue Riverside, CA 92503 Phone 951/354-4220 Fax 951/352-3422

HAS

2005 DEC 22 PM 4:53

DRAFT

Lake Elsinore and Canyon Lake Nutrient TMDL Monitoring Plan

December 19, 2005

Prepared for:
California Regional Water Quality Control Board, Santa Ana Region

Prepared by:
Lake Elsinore and San Jacinto Watersheds Authority

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APPENDIX

1.0 Introduction

In 1994, 1998 and again in 2002, Lake Elsinore and Canyon Lake were identified by the California Regional Water Quality Control Board, Santa Ana Region (Regional Board) on its Clean Water Act Section 303(d) list of impaired waters. Impairments identified for these waters included excessive levels of nutrients in both lakes, as well as, organic enrichment/low dissolved oxygen, sedimentation/siltation, and unknown toxicity in Lake Elsinore and high bacteria in Canyon Lake. As required by the Clean Water Act Section 303(d), waters that do not or are not expected to meet water quality standards (beneficial uses, water quality objectives) must implement a total maximum daily load[1] (TMDL). As a result, the Regional Board initiated the development of TMDLs for nutrients for Lake Elsinore and Canyon Lake.

Since 2000, local stakeholders, in cooperation with the Regional Board, have been working to identify the sources of nutrients causing impairment and evaluate their impacts to water quality and beneficial uses. Stakeholders have actively participated in annual watershed-wide stormwater quality and flow monitoring, as well as, water quality monitoring of Lake Elsinore and Canyon Lake. Grant funding has enabled stakeholders to develop models of the lakes to better understand the lake characteristics, as well as, a San Jacinto River Watershed model to simulate the wash off and transport of nutrients to the lakes. In addition, the Lake Elsinore & San Jacinto Watersheds Authority (LESJWA) has preformed numerous studies of the lakes and begun the implementation of projects to bring about improvements to in-lake water quality.

In 2004, the Regional Board prepared the Lake Elsinore and Canyon Lake Nutrient TMDL Report. This report framed the stakeholders monitoring and modeling efforts to characterize in-lake water quality and thus provide the basis for recommendations that the Regional Board consider revisions to the Implementation Plan (Chapter 5 of the Basin Plan) to incorporate the nutrient TMDLs for Canyon Lake and Lake Elsinore. These recommendations outlined in Resolution No. RB8-2004-0037 were adopted by the Regional Board in December 2004 and subsequently approved by the U.S. Environmental Protection Agency (US EPA) on September 30, 2005.

[1] Total maximum daily load (TMDL) is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources.

2.0 Nutrient TMDL Monitoring Requirement

This report addresses the obligation of stakeholders to submit to the Regional Board and implement a Nutrient Monitoring Program, Task 4 of Resolution No. RB8-2004-0037 for the Canyon Lake and Lake Elsinore nutrient TMDLs. As detailed in Task 4, the stakeholders[2] have prepared for review and approval by the Regional Board a nutrient monitoring plan. This plan addresses the requirements to implement nutrient monitoring program providing the data necessary to review and update the Lake Elsinore and Canyon Lake Nutrient TMDL including:

1. A watershed-wide monitoring program to determine compliance with interim and/or final nitrogen and phosphorus allocations; and compliance with the nitrogen and phosphorus TMDL, including the waste load allocations (WLAs) and load allocations (LAs).
2. A Lake Elsinore nutrient monitoring program to determine compliance with interim and final nitrogen, phosphorus, chlorophyll a, and dissolved oxygen numeric targets. In addition, this program will evaluate and determine the relationship between ammonia toxicity and the total nitrogen allocation to ensure that the total nitrogen allocation will prevent ammonia toxicity in Lake Elsinore.
3. Canyon Lake nutrient monitoring program to determine compliance with interim and final nitrogen, phosphorus, chlorophyll a, and dissolved oxygen numeric targets. In addition, the monitoring program will evaluate and determine the relationship between ammonia toxicity and the total nitrogen allocation to ensure that the total nitrogen allocation will prevent ammonia toxicity in Canyon Lake.

[2] Stakeholders include all signatory members, Task Force Members of the Lake Elsinore and Canyon Lake TMDL Task Force.

3.0 Nutrient TMDL Monitoring Program

The nutrient monitoring program described here within is consistent with Basin Plan requirements and considers monitoring recommendations presented by the Regional Board to track compliance with the TMDL's and associated load allocations, as well as, measuring compliance to in-lake numeric water quality targets. However, due to budgetary and staffing considerations, as well as, significant gaps in information required to understand in-lake and watershed processes this monitoring program considers a phased approach. This approach will enable stakeholders to focus resources on the most prominent data gaps and limitations to the nutrient TMDL calculation, while maintaining an agreed minimum level of compliance monitoring.

The program is proposed to be conducted in three general phases. Phase 1 of this program focuses on data issues regarding in-lake processes and the "linkage analysis" relating external pollutant loading to in-lake response and the associated predicted nutrient concentrations compared to numeric water quality targets. This key point in the TMDL calculation is not well understood and has a direct influence on the assessment of the required external load reductions to the lake. Phase 2 follows, focusing on intensive study in the watershed to address compliance monitoring, as well as addressing key data gaps in the watershed. A Phase 3 or the compliance monitoring phase is proposed to begin upon completion of the intensive data collection efforts of Phases 1 and 2. It is proposed that this monitoring phase consists of an agreed upon base level of in-lake and watershed compliance monitoring determined after many of the data gaps have been addressed.

The duration of Phase 1 is anticipated to be approximately 2-3 years depending on the completion of in-lake studies and the amount of data collected under Phase 1. Since the implementation schedule of the Lake Elsinore and Canyon Lake Nutrient TMDL allows reevaluation of the TMDL once every three years, it is envisioned that the results of the Phase 1 monitoring program will be used for the possible review and revision of the Nutrient TMDL. The process of conducting the more intensive in-lake monitoring program before proceeding with the Phase 2 intensive watershed monitoring program is reflective of the adaptive management approach in addressing the Lake Elsinore and Canyon Lake Nutrient TMDL.

3.1 Phase 1: Intensive Lake Study

Phase 1 monitoring of Lake Elsinore and Canyon Lake extends the previous data collection effort for trend analysis, and also focuses on collecting key information to address identified data gaps. Phase 1 monitoring stations within Canyon Lake and Lake Elsinore are consistent with those recommended by the Regional Board in the nutrient TMDL. Sampling methods at the lake stations will be consistent with existing Quality Assurance Performance Plans (QAPPs). Frequency of sampling is also consistent with previous lake monitoring plans, with monthly sampling from October through May, and bi-weekly from June through September.

To focus resources on intensive study of the lakes, the amount of watershed monitoring for Alterative 2 is reduced to the minimum required for determination of lake inputs and monitoring of compliance to load allocations reported in the nutrient TMDL's, as well as potentially quantifying loading from Mystic Lake in the event it overflows to the lower San Jacinto River. Figure 3-1 shows the location of the four TMDL stations recommended for monitoring in Phase 1. Consistent with Regional Board recommendations, sampling for Phase 1 includes multiple samples (8 samples for general water quality including nutrients) throughout the hydrograph of three storms per year.

In place of the more-intensive watershed monitoring, Phase 1 includes a focused number of parameters monitored in the lake, as well as special studies that can be added modularly as additional resources become available. Table 3-1 includes a summary of the lake and watershed monitoring and special studies included in Phase 1. Sections 3.1.1 and 3.1.2 provide additional discussion of the monitoring components, including the specific parameters to be measured, and summarize the investment required for implementation of each of the components of the monitoring plan. Section 3.1.3 provides discussion of special studies listed in Table 3-1.

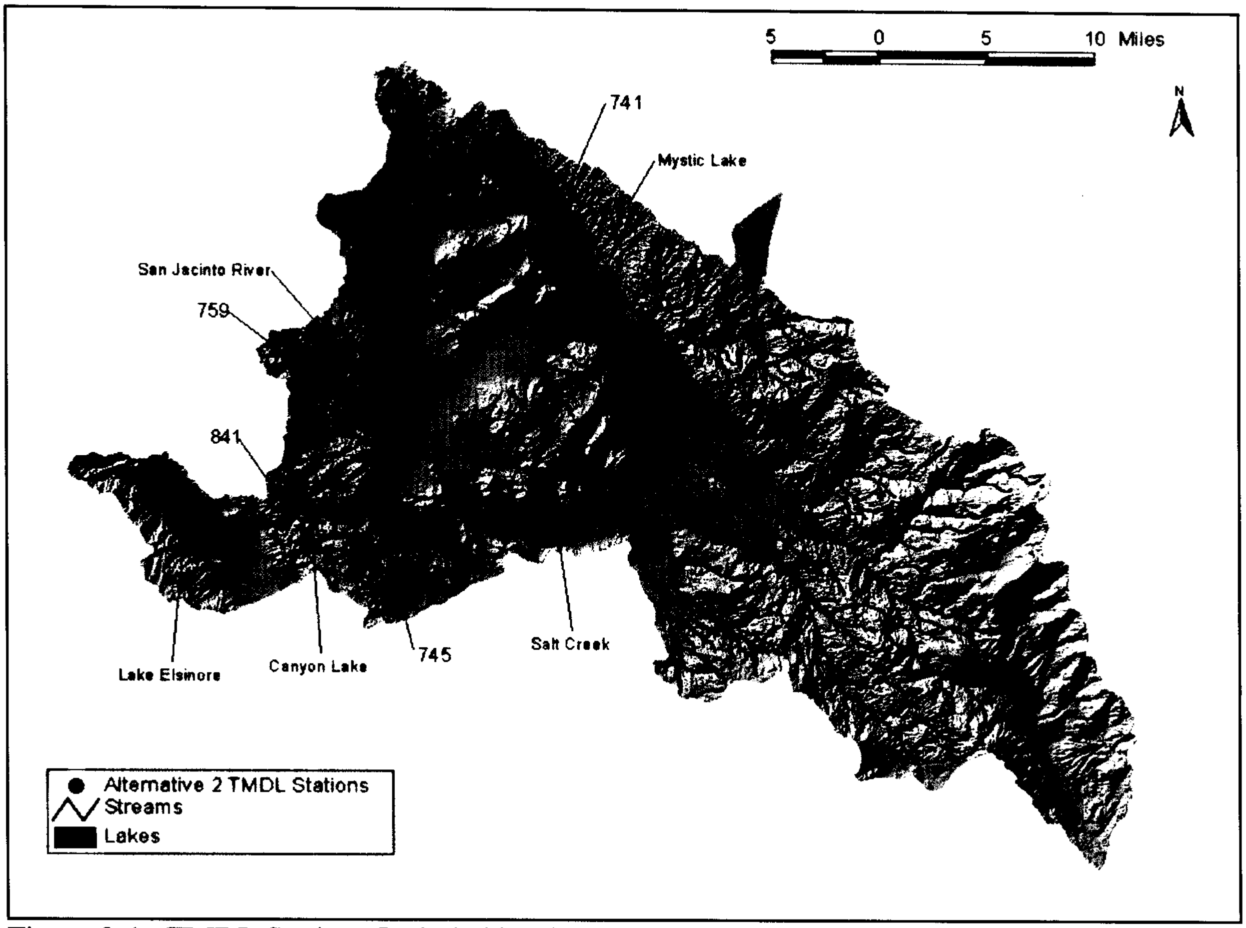

Figure 3-1. TMDL Stations Included in Phase 1

Table 3-1. Summary of Phase 1

DESCRIPTION	NUMBER OF STATIONS	DATA COLLECTED
Watershed Water Quality	4	12 water quality constituents sampled through hydrograph of 3 storm events per year[b]
Watershed Flow	4	Continuous flow at TMDL stations
Canyon Lake Water Quality	4[a]	20 water quality constituents (monthly Oct - May; biweekly June – Sept)
Lake Elsinore Water Quality	3	17 water quality constituents (monthly Oct - May; biweekly June – Sept)
SPECIAL STUDIES		
1. Sediment nutrient flux and SOD studies of both lakes		
2. Monitoring of dry-urban runoff flows and water quality at both lakes		
3. Study to evaluate benefits from in-lake projects (based on data collection above)		
4. Study to re-evaluate site-specific nutrient targets used for TMDL development (based on data collection above)		
5. Study to assess benefits of carp removal from Lake Elsinore		

[a] At least 3 stations with multiple vertical samples assumed based on depths at station locations.
[b] Eight samples collected for general water quality constituents including nutrients (9)

3.1.1 Phase 1 - Laboratory Analyses

Separate laboratory analyses are required for lake and watershed samples. The following sections discuss parameters to be measured for each sample and the total cost of laboratory analyses.

3.1.1.1 Lake Samples

For all samples collected from the Canyon Lake and Lake Elsinore TMDL stations, the following parameters are recommended for laboratory analyses:

- Water temperature
- Dissolved oxygen
- Specific conductance
- Chlorophyll *a*
- Nitrate nitrogen
- Nitrite nitrogen
- Ammonia nitrogen
- Total organic nitrogen
- Dissolved organic nitrogen
- Ortho phosphate
- Total organic phosphorus
- Dissolved organic phosphorus
- Chemical oxygen demand (COD)
- Biological oxygen demand (BOD)
- Total suspended solids (TSS)
- Total organic carbon
- Dissolved organic carbon

3.1.1.2 Watershed Samples

For all samples collected from the watershed TMDL stations, the following parameters are recommended for laboratory analyses:

- Total organic nitrogen
- Nitrite nitrogen
- Nitrate nitrogen
- Ammonia nitrogen
- Total phosphorus
- Ortho phosphate
- Total suspended solids (TSS)
- Chemical oxygen demand (COD)
- Biological oxygen demand (BOD)

3.1.2 Phase 1 – Flow Measurement Stations

Four flow measurement stations are necessary for monitoring at the TMDL stations shown in Figure 3-1. These four stations include three existing USGS gages and one existing RCFC gage, as shown in Table 3-2.

Table 3-2. Flow Gages Operated and Maintained for Phase 1

TMDL GAGE ID	USGS GAGE ID	LOCATION	AFFILIATED AGENCY
745	11070465	Salt Creek at Murrieta Road	USGS
759	11070365	San Jacinto River at Goetz Road	USGS
741	11070210	San Jacinto River at Ramona Expressway	USGS
841	N/A	Canyon Lake Spillway	RCFC

3.1.3 Phase 1: Lake Special Studies

In addition to the studies identified in this section, additional special studies in the lakes to be considered to further address data gaps, advance understanding of nutrient cycling within the lakes, and refine assumptions and models for TMDL development. The ability to conduct these studies would be dependent on funding levels available. These studies are discussed in the following sections.

3.1.3.1 Sediment Nutrient Flux and Oxygen Demand Studies

Previous studies have demonstrated that flux of nutrients from the sediments is a critical process in Lake Elsinore and Canyon Lake (Anderson, 2001; Anderson and Oza, 2003; SAWPA 2003). However, previous nutrient flux studies of the lakes were performed during particularly dry years. As in-lake processes are expected to vary based upon environmental conditions, the lake levels and nutrient inputs related to wet- and dry-weather flows are expected to play a significant role in the rate of nutrient flux from Lake Elsinore sediments. The anticipated differences in nutrient flux rate will illustrate the varying flux rates and nutrient cycling patterns under different hydrologic conditions. Such an understanding will be valuable to the development of more precise models for use in predicting in-lake conditions and processes.

This proposed special study includes continuation of nutrient flux studies conducted by University of California, Riverside for both lakes (Anderson, 2001; Anderson and Oza, 2003). However, in order to reduce costs and maximize the environmental realism of flux estimates, all flux studies will be performed *in situ*. As with the previous study, this will use equilibrium dialyzers that are placed and allowed to equilibrate in the field. The chemical gradients in the sediments are then measured after a 28-day exposure period. Four quarterly measurements are recommended for representation of seasonal variations of fluxes during one year. Four stations are recommended for sampling in Canyon Lake; three stations are recommended for Lake Elsinore.

In addition, corresponding measurements of sediment oxygen demand (SOD) are recommended for measurement at all seven lake stations mentioned above. These data will assist greatly in analysis of dissolved oxygen levels in the lake and effects of multiple influences.

3.1.3.2 Monitoring of Dry-weather Runoff Flows and Water Quality

In order to develop the best understanding of the influences of dry-weather runoff on Lake Elsinore and Canyon Lake water quality, it is necessary to quantify the dry-weather inputs from surrounding communities and major tributaries. Stormwater drains and flowing tributaries should be sampled on a monthly basis during the dry weather season (June – September). These samples should be analyzed for nutrients (organic nitrogen, nitrite, nitrate, ammonia, total phosphorus, and orthophosphate) at both lakes. Also, the flow should be measured at the time of sample collection.

Such monitoring of the dry weather flows will help identify major inputs of nutrients contaminants to the lakes during the warmer growing season. Further, a more complete description of inputs to the lakes during the dry season will complement an existing body of knowledge of wet-weather inputs to this system. Together, these data will allow the most complete understanding of influences on the lakes to be addressed. This knowledge will then facilitate the most efficient use of limited resources in mitigation of these impacts through best management practices and use of other available technologies.

3.1.3.3 Study to Evaluate Benefits from In-lake Projects

Based on data collected from both lakes during the monitoring outlined above, analyses can be performed to evaluate benefits observed from in-lake projects. Such projects include aeration of Lake Elsinore and dredging of Canyon Lake. Similar studies are recommended in the implementation plan of the *Lake Elsinore and Canyon Lake Nutrient TMDL* (Tasks 9 and 10).

3.1.3.4 Study to Re-evaluate Site-specific Nutrient Targets

For nutrient TMDL development of both lakes, site-specific numeric targets were established based on reference conditions when beneficial uses of the lake were not considered significantly impacted by nutrients. Further study of these impacts can further refine the cause-and-effect relationship between nutrient levels and impairments to beneficial uses, including assessment of nuisance algae levels and dissolved oxygen variability that can be influenced by nutrient levels and biological activity. Also, the implementation plan of the *Lake Elsinore and Canyon Lake Nutrient TMDL* (Task 13) includes a review and potential revision of total inorganic nitrogen number targets for the lakes, as well as an evaluation of the appropriateness of establishing total phosphorus and un-ionized ammonia numeric water quality objectives for both lakes.

Analysis of previous and current monitoring data can provide sufficient data for assessment. In addition, development of dynamic models that provide full simulation of eutrophic processes can assist in understanding cause-and-effect relationships. However, if model results are to assist in analysis, associated model development is assumed performed in separate studies.

3.1.3.5 Study to Assess Benefits of Carp Removal from Lake Elsinore

Since 2002, carp removal projects have been implemented in Lake Elsinore to reduce populations that potentially re-suspend sediment and associated nutrients, as well as create additional nutrients through waste production. To date, about 1.1 million pounds of carp have been removed as a result of this project (per communication with David Ruhl, SAWPA). For the nutrient TMDL, the Regional Board made assumptions regarding rates of nutrient re-suspension that can be refined or updated based on new data regarding reduced carp populations and impacts on re-suspension. The Regional Board has recommended further study of these water quality benefits (per communication with Cindy Li, Regional Board). Continued water quality monitoring at the lake should provide information for assessment of trends in water quality that can potentially correlate with carp removal. Additional studies of sediment re-suspension or settling, such as in-situ sediment traps, can further assist in refining assumptions for sediment/nutrient re-suspension. Development of cost estimates for this study is dependent upon the amount of water quality data available for trend analysis, and preferences by stakeholders and the Regional Board regarding necessary data to support development of acceptable assumptions for sediment/nutrient re-suspension.

3.2 Phase 2: Intensive Watershed Study

This data collection strategy, outlined in Phase 2 is a combination of watershed monitoring and previous and new TMDL stations, as well as special studies to be pursued when adequate resources become available. This phase of the monitoring program focuses intensive study in the watershed to address compliance monitoring as well as addressing key data gaps in the watershed. Monitoring in both lakes is maintained to provide assessment of compliance to numeric water quality targets and continue to provide information for future model testing.

Watershed TMDL stations recommended for Phase 2 are shown in Figure 3-2. These include nine previous TMDL stations that included flow gages, one previously investigative TMDL station on the San Jacinto River at Bridge St. (Station 835) that currently does not include flow measurements, and three new TMDL stations. Discussion of locations and rationale for these stations are provided below.

- A new TMDL station is recommended on a small tributary of the San Jacinto River above Canyon Lake known as Meadowbrook, which is likely to regularly contribute flows and associated pollutant loadings to Canyon Lake during various storm magnitudes. Monitoring in the Meadowbrook watershed can also provide information for this area regarding representation of potential impacts of septic failures that can have substantial impact on nutrient runoff. Potential locations of monitoring stations are shown in Figure A-1 of Appendix A and corresponding photos Figures A-1a, A-1b and A-1c.
- A new TMDL station is recommended in Moreno Valley on the Kitching St. Channel at Iris Ave., as shown in Figure A-2 of Appendix A and corresponding photo Figure A-2a. This location drains a small watershed that is primarily developed (residential). Currently, only the Hemet Channel station (318) provides representation of urban stormwater runoff in the watershed. To test transferability of urban modeling parameters to other areas and to provide characterization of urban runoff from the northwest portion of the watershed, the Kitching St. Channel provides an ideal location for monitoring.
- Conversion of TMDL Station 835, located on the San Jacinto River at Bridge St., to a complete water quality and flow measurement station will provide insight into loadings to Mystic Lake and sources from upstream croplands and dairies. Although the flows at this station may not represent all flows to Mystic Lake during specific storm magnitudes due to the multiple pathways of storm flows, this key location can continue to provide a record of pollutant loads and flows to assist in understanding this complexity. Figure A-3 of Appendix A shows the location of the Station 835.

- A new station is recommended at an existing USGS gage on San Jacinto River at State St. (USGS 11070150), as shown in Figure A-4 of Appendix A. This station can provide improved understanding of pollutant loadings to Mystic Lake. Also, substantial reduction of San Jacinto River flows have been observed upstream of the State St. gage, likely resulting from high infiltration capacity of the streambed. To address this infiltration loss, new model refinements may be required.

Special studies can be performed to address other data gaps not answered through typical watershed monitoring. One important data gap is the storage and in-lake nutrient cycling within Mystic Lake. Continued monitoring downstream of Mystic Lake on the San Jacinto River and Ramona Expressway (TMDL Station 741) can provide information in the case that the lake overflows, however data collection within the lake can also provide a great deal of information for modeling assumptions, such as storage volume and overflow hydraulics. Other special studies of agricultural management practices and changes in land use are also recommended in Phase 2.

Table 3-3 includes a summary of the lake and watershed monitoring and special studies included in Phase 2. Sections 3.2.1 through 3.2.2 provide additional discussion of the monitoring components, including the specific parameters to be measured, and summarize the investment required for implementation. Section 3.2.3 provides discussion of special studies listed in Table 3-3.

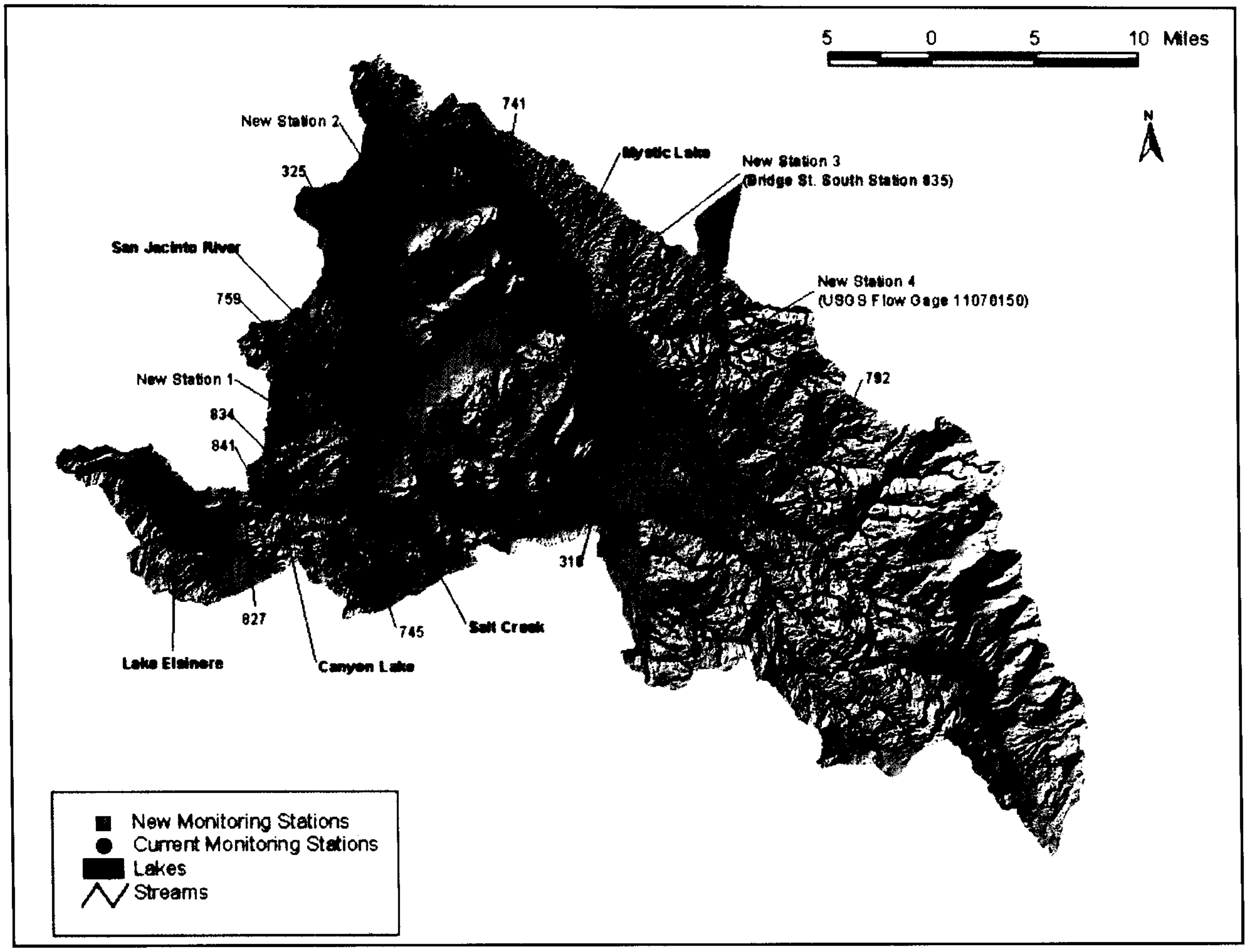

Figure 3-2. TMDL Stations Included in Phase 2

Table 3-3. Summary of Phase 2

DESCRIPTION	NUMBER OF STATIONS	DATA COLLECTED
Watershed Water Quality	13	10 water quality constituents sampled through hydrograph of 3 storm events per year[b]
Watershed Flow	13	Continuous flow at TMDL stations
Canyon Lake Water Quality	4[a]	15 water quality constituents (monthly Oct - May; biweekly June – Sept)
Lake Elsinore Water Quality	3	12 water quality constituents (monthly Oct - May; biweekly June – Sept)
SPECIAL STUDIES		
1. Bathymetric survey of Mystic Lake and development of inflow and stage-outflow relationships		
2. Mystic Lake in-lake water quality monitoring		
3. Assessment of agricultural manure/fertilizer application and spatial variability of crop types in the watershed		
4. Update of land use dataset		

[a] At least 3 stations with multiple vertical samples assumed based on depths at station locations.
[b] Eight samples collected for general water quality constituents including nutrients (7)

3.2.1 Phase 2 - Laboratory Analyses

Separate laboratory analyses are required for lake and watershed samples. The following sections discuss parameters to be measured for each sample and the total cost of laboratory analyses.

3.2.1.1 Lake Samples

For all samples collected from the Canyon Lake and Lake Elsinore TMDL stations, the following parameters are recommended for laboratory analyses:

- Water temperature
- Dissolved oxygen
- Chlorophyll *a*
- Nitrate nitrogen
- Nitrite nitrogen
- Ammonia nitrogen
- Total organic nitrogen
- Ortho phosphate
- Total organic phosphorus
- Chemical oxygen demand (COD)
- Biological oxygen demand (BOD)
- Total suspended solids (TSS)

In addition, samples collected from the Canyon Lake *surface* should include laboratory analysis of fecal coliform, total coliform, and *E. coli.*

3.2.1.2 Watershed Samples

For all samples collected from the watershed TMDL stations, the following parameters are recommended for laboratory analyses:

- Total organic nitrogen
- Nitrite nitrogen
- Nitrate nitrogen
- Ammonia nitrogen
- Total phosphorus
- Ortho phosphate
- Total suspended solids (TSS)

3.2.2 Phase 2 – Flow Measurement Stations

Thirteen flow measurement stations are necessary for monitoring at the TMDL stations shown in Figure 3-2. These thirteen stations include seven existing USGS gages, three existing RCFC gages, and three new flow gages requiring installation. Table 3-4 lists all flow gages included in Phase 2 (new flow gages are highlighted).

Table 3-4. Flow Gages Operated and Maintained for Phase 2

TMDL GAGE ID	USGS GAGE ID	LOCATION	AFFILIATED AGENCY
792	11069500	San Jacinto River at Cranston Guard Station	USGS
745	11070465	Salt Creek at Murrieta Road	USGS
759	11070365	San Jacinto River at Goetz Road	USGS
325	11070270	Perris Valley Storm Drain at Nuevo Road	USGS
741	11070210	San Jacinto River at Ramona Expressway	USGS
827	11070500	San Jacinto River Upstream of Lake Elsinore	USGS
834	N/A	Sierra Park Drain in Canyon Lake	RCFC, City of Canyon Lake
318	N/A	Hemet Channel at Sanderson Ave	RCFC
841	N/A	Canyon Lake Spillway	RCFC
NEW	11070150	San Jacinto River at State St.	USGS, EMWD, RCFC
835	N/A	San Jacinto River @ Bridge St.	?
NEW	N/A	Meadowbrook	?
NEW	N/A	Kitching St. Channel @ Iris Ave.	?

3.2.3 Phase 2: Watershed Special Studies

The reduced cost of Phase 2 monitoring allows opportunity for allocation of resources to pursue special studies in the watershed to further address data gaps, and advance understanding of hydrology and pollutant sources and transport from the watershed. Furthermore, these studies can provide essential information for update of models and re-evaluation of the source assessments performed for development of TMDL's and associated load allocations. These studies are discussed in the following sections.

3.2.3.1 Bathymetric Survey of Mystic Lake and Development of Assumptions for Inflow and Outflow

The RCFC has recently performed a bathymetric survey of Mystic Lake to further understanding of the storage of the lake during high flows. This information can be used to develop stage-storage relationships and assumptions estimating outflow hydraulics. Based upon the bathymetric data, hydrologic modeling analysis of the lake can be performed to determine relationships between lake water surface elevation and outflow. In the absence of lake outflow data, assumptions will likely require development based on survey data of the lake outflow location. Once outflows are measured by the downstream flow gage on San Jacinto River at Ramona Expressway, these data can be used to test modeling assumptions.

Additional study of the lake inflow hydraulics can improve understanding of the multiple pathways of flow from the San Jacinto River and the transport of pollutant loads from land use practices (e.g., croplands; dairies) in close proximity to each pathway. For instance, water quality and flows measured at the San Jacinto River at Bridge St. may be representative of most of the upstream watershed runoff during low flows, however at high flows the capacity of the channel at this location can be exceeded resulting in diversion of upper watershed flows through alternative channels in the floodplain. The uncertainty of the flooding of areas and multiple flow pathways can be determined based on high-resolution surveys (e.g., 1-2 ft. contours) and hydraulic modeling of the floodplain. (An example hydraulic model is HEC-RAS, which can provide simulation of flows and water depth based on detailed cross-sectional information). This information, combined with hydraulic modeling of Mystic Lake described above, can result in improved understanding of a segment of the San Jacinto River that is largely a mystery in terms of hydrology and influence on pollutant transport from the upper portion of the watershed through Mystic Lake to Canyon Lake.

This special study addresses a project identified in the *San Jacinto Nutrient Management Plan* (LESJWA, 2004) to address data gaps in the watershed (Project 18). Specifically, this project recommended data collection and study of lake bathymetry, inflow and outflow hydraulics, and in-lake water quality. A significant portion of this effort has already been completed by RCFC through collection of bathymetric data of Mystic Lake. The special study described above focuses on understanding the storage and inflow/outflow hydraulics of the lake.

3.2.3.2 Mystic Lake In-lake Water Quality Monitoring

Currently there are no known water quality data collected from Mystic Lake to assess conditions of the lake when storage occurs. This sampling will allow for a more precise understanding of the properties of Mystic Lake and the role it may potentially play in the storage and release of nutrients in the San Jacinto watershed. This understanding will facilitate the development of more precise models of the transport of nutrients and contaminants. This, in turn, will promote efficient use of limited resources in mitigation of nutrient inputs and related effects in the watershed. This special study recommends monthly sampling at a single site at the deepest part of the lake center. The following parameters presented in Table 3-5 should be measured at one-meter interval:

Table 3-5. Mystic Lake Monitoring – Phase 2 Special Study

DEPTH	PARAMETER	LOCATION OF ANALYSIS	SAMPLING FREQUENCY
N/A	Water depth, secchi depth	Field	Monthly
Ever 3 feet in depth	Dissolved oxygen, pH, conductivity, temperature	Field	Monthly
Photic zone	Chlorophyll a (composited from 3 samples), total coliform, fecal coliform, *E. coli*	Laboratory	Monthly
Sampled at 3-ft intervals and composited	Organic nitrogen, nitrite, nitrate, ammonia, total phosphorus, orthophosphate	Laboratory	Monthly

3.2.3.3 Assessment of Agricultural Manure/Fertilizer Application and Spatial Variability of Crop Types in the Watershed

The *San Jacinto Nutrient Management Plan* (LESJWA, 2004) identifies a needed study for determining crop-specific agronomic rates for guidance in fertilizer and manure application management in the watershed (Project 14). This project includes the following components:

- Spatial inventory (GIS) of crop distributions in the watershed; if crops are rotated throughout the year, each crop and associated season will be included in the inventory.
- Estimation of seasonal nutrient application rates for each crop type. For both fertilizer and manure, content will be assessed to determine quantities of nitrogen and phosphorus. If management of specific farms varies significantly for identical crop types, nutrient

application rates will be estimated and catalogued separately for each farm so that spatial variability in the watershed will be representative of such conditions.

- Estimation of agronomic rates associated with each crop type for both nitrogen and phosphorus.

In addition, the implementation plan of the *Lake Elsinore and Canyon Lake Nutrient TMDL* (Task 5) requires development of a nutrient management plan by agricultural operators, in cooperation with the Riverside County Farm Bureau, the University of California Cooperative Extension, and the Western Riverside County Agricultural Coalition (WRCAC), to meet Regional Board approval (Regional Board, 2004). The Regional Board states that this plan must include the following:

- Implementation of nutrient controls, BMPs, and reduction strategies to meet load allocations;
- Evaluation of effectiveness of BMPs;
- Development and implementation of compliance monitoring; and
- Development and implementation of focused studies that will provide the following data and information:
  - Inventory of crops grown in the watershed;
  - Amount of manure and/or fertilizer applied to each crop with corresponding nitrogen and phosphorus amounts; and
  - Amount of nutrients discharged from croplands.

Ongoing and proposed studies performed by the SAWPA, EMWD, the University of California, Riverside, the WRCAC, the San Jacinto River Watershed Council, and various agricultural operators can address components of the projects outlined above.

3.2.3.4 Update of Land Use Dataset

The San Jacinto River watershed is currently undergoing major changes due to development of previous open space or agricultural lands. Previous model development of the watershed to support nutrient and TMDL development was based on a combination of land use data collected in 1993 by USGS and 1999 by EMWD (SAWPA, 2003). To assess the changes in hydrology and pollutant transport due to the rapidly changing land use, new land use data is required. To obtain a better understanding of current land us, EMWD plans to update their previous dataset to current conditions. Once collected, this data can be used to update the previously developed watershed model to assess changes in pollutant transport and impacts on Canyon Lake and Lake Elsinore.

References

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SAWPA (Santa Ana Water Project Authority). 2003. Lake Elsinore and Canyon Lake Nutrient Source Assessment - Final Report. Prepared by Tetra Tech, Inc.

Appendix A

Potential Locations of New Watershed Monitoring Stations for Phase 2

Figure A-1. Potential Locations for Monitoring Station at Meadowbrook

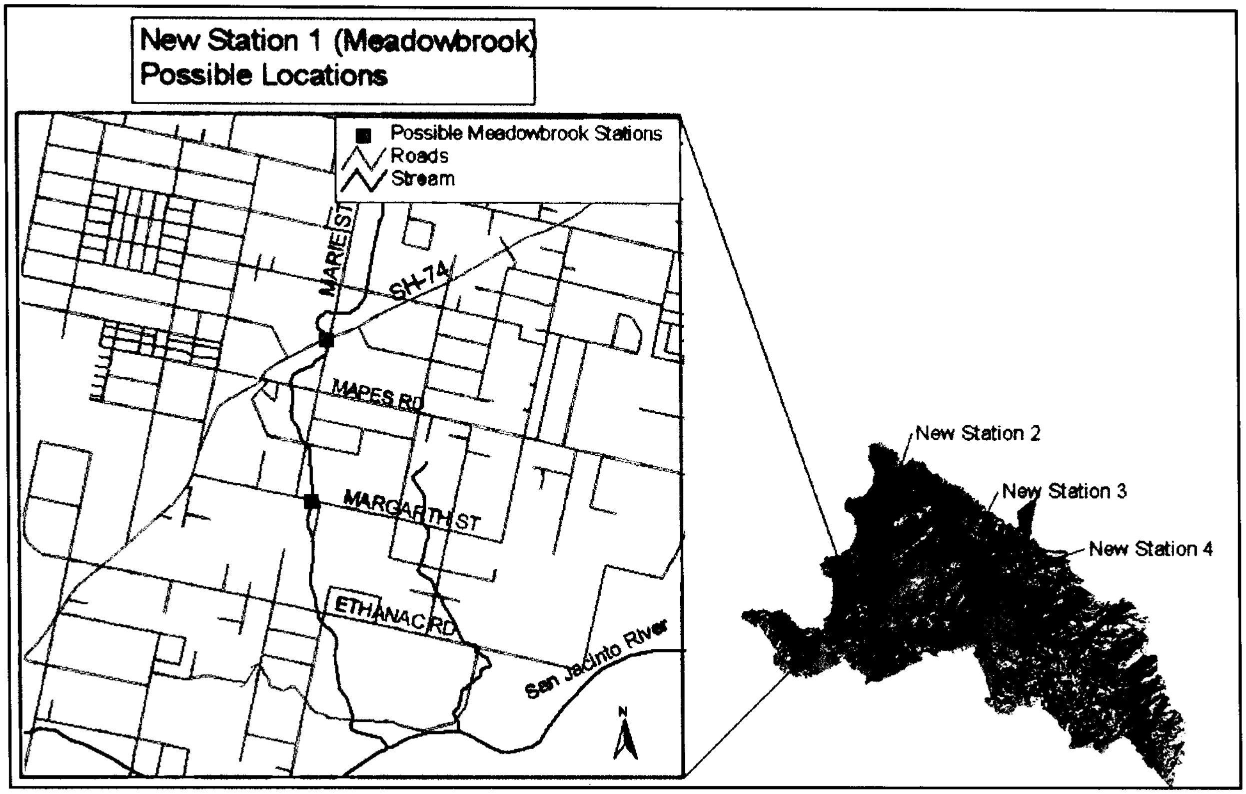

Figure A-1a. Candidate monitoring station #1 in Meadowbrook (Margarth Rd)

Figure A-1b. Candidate monitoring station #1 in Meadowbrook (Margarth Rd)

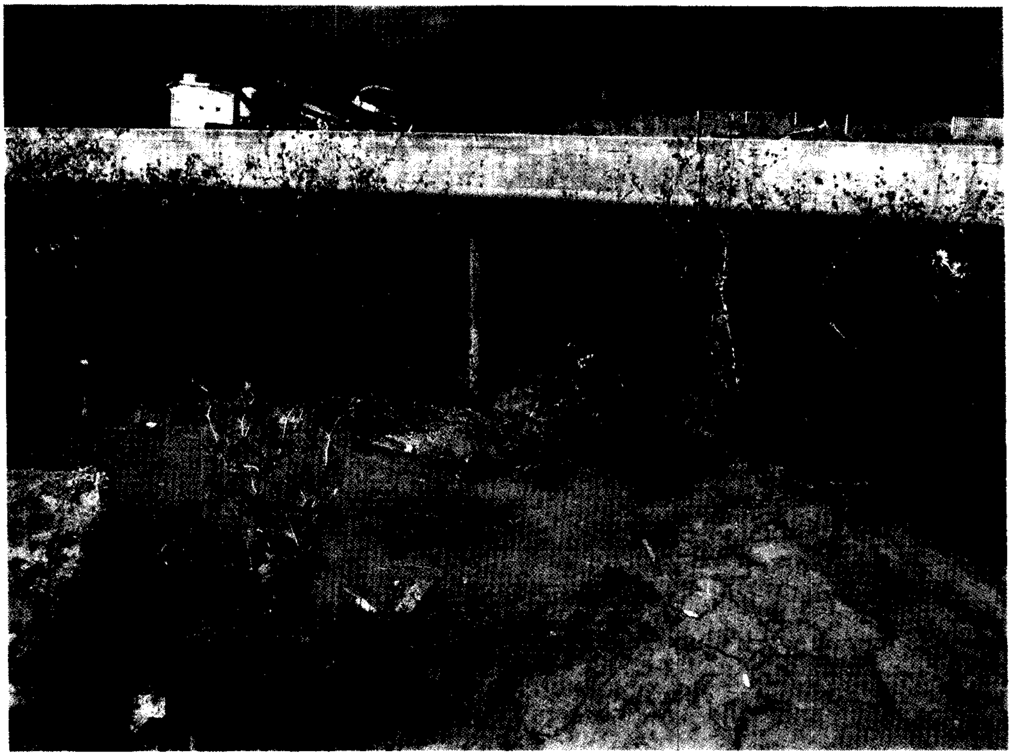

Figure A-1c. Candidate monitoring station #2 in Meadowbrook (Highway 74)

Figure A-2. Potential Location for Monitoring Station at Kitching St. at Iris Ave.

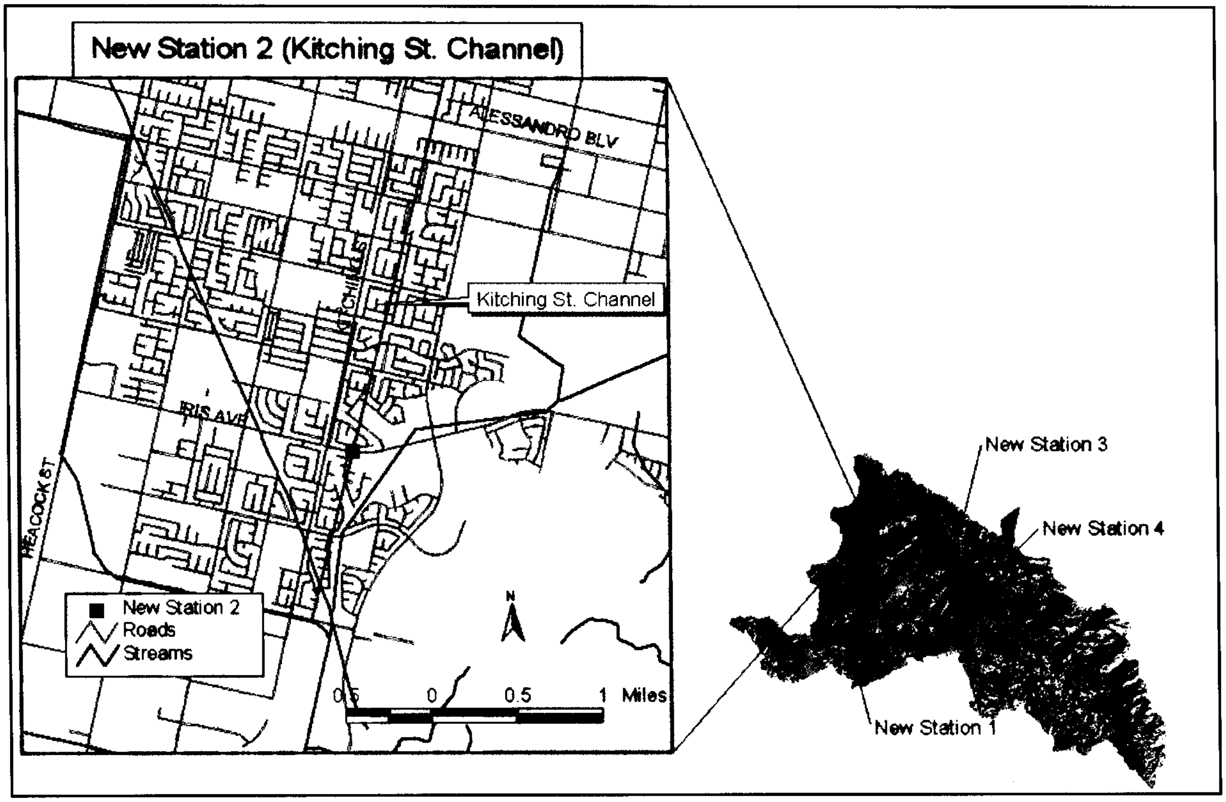

Figure A-2a. Candidate monitoring station at Kitching St. Channel

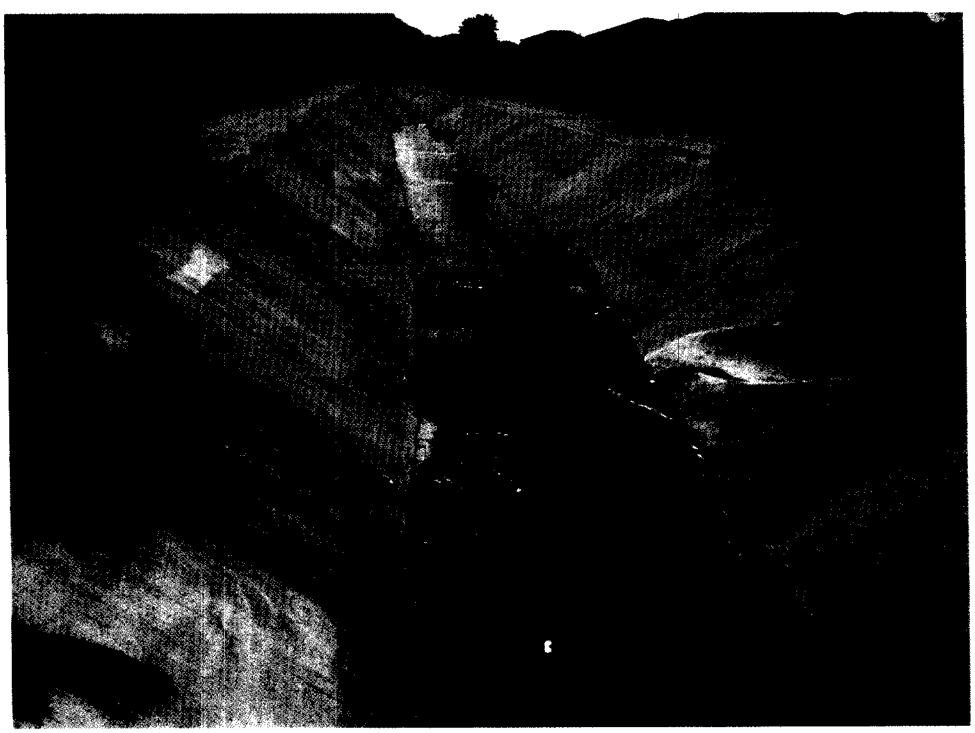

Figure A-3. Location for Monitoring Station on San Jacinto River at Bridge St.

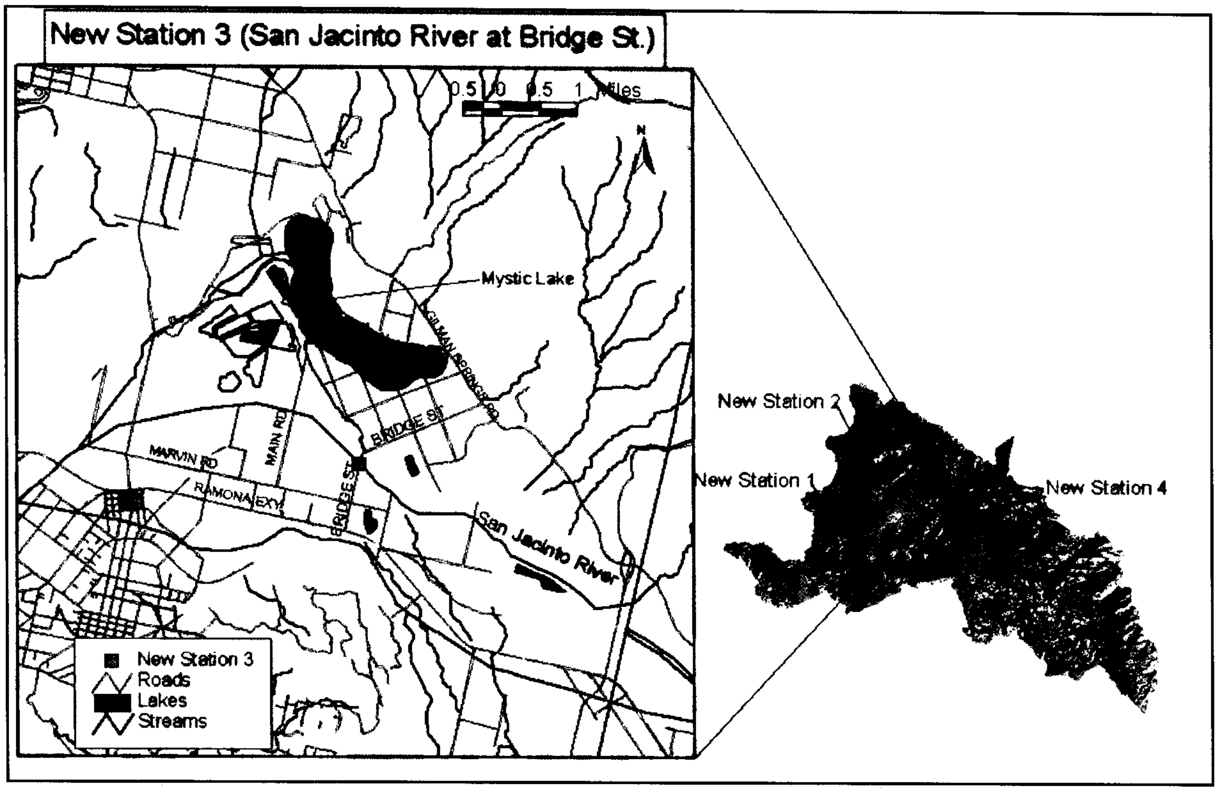

Figure A-4. Location for Monitoring Station on San Jacinto River at State St.